REMARKS

This application has been carefully reviewed in light of the Office Action dated July 16, 2003. Claims 1, 36 and 64 have been amended. Claims 1-13, 15-25, 36-39, 41-46 and 64-70 are currently pending. Applicant respectfully requests reconsideration of the above-referenced application in light of the amendments and following remarks.

Claims 36-39 and 41-46 stand rejected under 35 U.S.C. §112, second paragraph, as being indefinite. Independent claim 36 has been amended to overcome the Examiner's concerns. As such, claim 36 and dependent claims 37-39 and 41-46 are believed to be in compliance with 35 U.S.C. § 112, second paragraph. Accordingly, Applicant respectfully requests that the rejection be withdrawn and claims 36-39 and 41-46 be allowed.

Claims 1, 3-12, 15-18, and 20-23 stand rejected under 35 U.S.C. § 102(b) as being anticipated by Ding. The rejection is respectfully traversed and reconsideration is requested.

Claim 1 recites a method of forming a contact opening in an insulative layer formed over a substrate in a semiconductor device comprising, "etching said insulative layer with an etching composition consisting essentially of ammonia and at least on fluorocarbon so as to form said contact opening, wherein the flow rate ratio of said at least one fluorocarbon to said ammonia is from about 2:1 to about 40:1, and said flow rate of said ammonia is in the range from about 2 sccm to about 6 sccm."

Applicant respectfully submits that Ding does not disclose, teach or suggest the limitations recited in claim 1. Ding, by contrast, teaches an etching composition comprising at least three different gases. Specifically, a fluorohydrocarbon gas, an NH_3-generating gas, and a carbon-oxygen gas (Col. 5, lines 46-55). Ding teaches that the flow rate of NH_3-generating gas <u>is 11 sccm</u> (<u>See</u> Cols. 11-12 and Examples 1-4). Accordingly, Ding does <u>not</u> teach that the "flow rate of said ammonia is in the range from about 2 sccm

to about 6 sccm," as recited in claim 1. As such, the claimed invention is not anticipated by Ding.

Claims 3-12, 15-18 and 20-23 depend from claim 1are allowable along with claim 1 for at least the reasons set forth above.

Claims 1, 3-5, 8-10, 12 and 15-16 stand rejected under 35 U.S.C. § 102(b) as allegedly being unpatentable over Toshiharu Yanagida ("Yanagida"). The rejection is respectfully traversed and reconsideration is requested.

Claim 1 recites a method of forming a contact opening in an insulative layer formed over a substrate in a semiconductor device comprising, "etching said insulative layer with an etching composition consisting essentially of ammonia and at least on fluorocarbon so as to form said contact opening, wherein the flow rate ratio of said at least one fluorocarbon to said ammonia is from about 2:1 to about 40:1, and said flow rate of said ammonia is in the range from about 2 sccm to about 6 sccm."

Applicant respectfully submits that Yanagida does not disclose, teach or suggest the limitations recited in claim 1. Specifically, Yanagida does <u>not</u> teach that the "flow rate ratio of said at least one fluorocarbon to said ammonia is from about 2:1 to about 40:1" as recited in claim 1. Although Yanagida teaches the use of ammonia and fluorocarbon, Yanagida does <u>not</u> disclose, teach or suggest the flow rate ratio of a fluorocarbon to ammonia.

Yanagida also does not teach that the "flow rate of said ammonia is in the range from about 2 sccm to about 6 sccm," as further recited in claim 1. Yanagida merely teaches "NH3 20 sccm . . . [and] NH3 10 sccm," (Paragraphs 29-34). As such, Yanagida does not teach Applicant's claimed flow rate range for NH_3.

For at least the foregoing reasons, claim 1 is allowable over Yanagida. Claims 3-5, 8-10, 12 and 15-16 depend from claim 1 and are allowable along with claim 1.

Claim 1-13, 15-25, 36-39, 41-46 and 64-70 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Tan in view of Ding. The rejection is respectfully traversed and reconsideration is requested.

Claim 1 recites a method of forming a contact opening in an insulative layer formed over a substrate in a semiconductor device comprising, "etching said insulative layer with an etching composition consisting essentially of ammonia and at least on fluorocarbon so as to form said contact opening, wherein the flow rate ratio of said at least one fluorocarbon to said ammonia is from about 2:1 to about 40:1, and said flow rate of said ammonia is in the range from about 2 sccm to about 6 sccm."

Claim 36 recites a process for forming an opening in an insulative layer formed over a substrate in a semiconductor device comprising, "forming a pair of adjacent gate stacks over said substrate, forming sidewall spacers on sidewalls of said adjacent gate stacks, forming an insulative layer over said substrate, forming a patterned photoresist mask layer over said insulative layer, and etching an opening in said insulative layer defined at least in part by said sidewall spacers through an aperture in said patterned resist layer . . . using a combination consisting essentially of ammonia and at least one fluorocarbon . . . wherein the flow rate ratio of said at least one fluorocarbon to said ammonia is from about 2:1 to about 40:1 and wherein the step of etching an opening in said insulative layer forms a protective layer on said sidewall spacers that is from about 5 to about 50 Å thick."

Claim 64 recites a method of forming a conductive plug formed in an insulative layer comprising, "contacting said insulative layer with a plasma etchant mixture consisting essentially of ammonia and at least one fluorocarbon at a temperature within the range of from about -50 to about 80 degrees Celsius so as to form a self-aligned contact opening defined at least in part by said sidewall spacers . . . wherein said contacting further forms a protective layer over opposed sidewall spacers which have been formed over said adjacent gate stacks that is from about 5 to about 50 Å thick, wherein the flow rate ratio of said at least one fluorocarbon to said ammonia is from about 2:1 to about 40:1 . . . and depositing a conductive plug inside said etched opening."

The Office Action asserts that Tan teaches "providing the substrate comprising adjacent gate stacks . . . comprising opposed side wall spacers . . . which have been formed over the gate stacks, forming the insulative layer over the substrate, the adjacent gate stacks and the side wall spacers which have been formed over the adjacent gate stacks." (Office Action, pg. 5).

Applicant respectfully submits, however, that none of the claims recite what the Office Action asserts. Independent claim 36 recites, "forming a pair of adjacent stacks over said substrate [and] forming sidewall spacers on the sidewalls of said adjacent gate stacks." Applicant does not claim side wall spacers formed over the gate stack nor that the gate stacks and sidewall spacers are formed over the gate stacks.

Ding is relied upon for teaching "a plasma etchant mixture essentially consisting of ammonia and said fluorocarbon of a ratio flow rate of the fluorocarbon to ammonia of 2:1 to 40:1 with the flow rate of said ammonia at least about 2 sccm to form the self-aligned contact opening at a temperature of about -50 to 80°C with further forming a protective layer over the opposed side wall spacers of the adjacent gate stacks." (Office Action, pg. 6). The Office Action concludes that it would have been obvious for Tan to use the plasma etchant mixture taught in Ding to "etch the self-aligned contact with a better etch rate and improved etch selectivity without an etch stop [and] that combination of the process . . . will form a protective layer containing nitrogen over the opposed side wall spacers in the self-aligned contact opening." (Office Action, pg. 7).

Applicant respectfully submits that Tan and Ding are not properly combinable references for purposes of a § 103(a) rejection. Tan teaches that a "self-aligned contact is formed by using <u>different</u> etching rates . . . to perform the etching process." (Col. 2, lines 23-32) (emphasis added). The etchant composition that Tan teaches has a "<u>higher etching rate</u> for the silicon oxide layer serving as a dielectric layer than for the silicon nitride layer used for the spacer and the cap layer." (Col. 2, lines 27-30) (emphasis added). As a result, "the etching rate of the spacer and the cap layer <u>can be ignored</u> and the etching process <u>stops on the spacer</u> and the cap layer." (Col. 2, lines 23-32) (emphasis added).

In contrast, Ding teaches a plasma etchant mixture which results in "polymeric passivating deposits 46 [which] are typically formed <u>on the sidewalls</u> 48 of the etched features 45." (Col. 4, lines 24-25) (emphasis added). Tan teaches an etchant mixture that will <u>stop</u> on the sidewalls of the spacer. If Ding's etchant mixture is used in Tan, then the etchant mixture would <u>not</u> stop on the sidewalls of the spacer, but would stop on the polymeric coating layer that Ding's plasma etchant mixture would generate. The resulting structure in Tan would <u>not</u> be a self-aligned contact window.

Moreover, it would not be beneficial to increase the etching rate in Tan. Tan benefits from the two <u>different</u> etch rates. A faster etching rate in Tan is <u>not desired</u> since the slower etching rate of the nitride layer results in the plasma etch <u>stopping</u> at the sidewall spacers.

Still further, even if the references are properly combinable, which they are not, the cited references would not teach or suggest the invention defined by any of claims 1, 36 and 64. In particular, the cited references fail to teach or suggest "an etching composition consisting essentially of ammonia . . . and the flow rate of said ammonia is in the range from about 2 sccm to about 6 sccm," as claim 1 recites, or that "the step of etching an opening in said insulative layer forms a protective layer on said sidewall spacers that is from about 5 to about 50 Å thick," as recited by claim 36, or using a "plasma etchant mixture . . . forms a protective layer over opposed sidewall spacers . . . that is from about 5 to about 50 Å thick," as recited by claim 64. Neither reference alone in or combination teaches or suggests a thickness for a protective layer formed on the sidewall spacers.

Claims 2-13 and 15-25 depend from a claim 1 and are allowable for at least the reasons provided above with regard to claim 1. Claims 37-39 and 41-46 depend from claim 36 and are allowable for at least the reasons provided above with regard to claim 36. Claims 65-70 depend from claim 64 and are allowable for at least the reasons provided above with regard to claim 64. Accordingly, the rejection should be withdrawn and the claims allowed.

Claim 2, 6-7, 11-13, 15-18, 36-39, 41-46 and 64-70 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Yanagida in view of Tan. The rejection is respectfully traversed and reconsideration is requested.

Claim 2 depends from claim 1 and recites, "[t]he method of claim 1, wherein said method is performed to produce a self-aligned contact opening, said opening is self-aligned between two adjacent gate stack structures with side wall spacers."

Accordingly, for the reasons provided above with regard to claim 1, Yanagida does not teach or suggest that the "flow rate ratio of said at least one fluorocarbon to said ammonia is from about 2:1 to about 40:1 [or] . . . that the flow rate of said ammonia is in the range from about 2 sccm to about 6 sccm."

Claims 2, 6-7, 11-13 and 15-18 depend from and include all of the limitations of independent claim 1 and are allowable for at least those reasons provided above with regard to claim 1.

Moreover, Yanagida does not teach or suggest "etching an opening . . . using a combination consisting essentially of ammonia and at least one fluorocarbon . . . wherein the flow rate ratio . . . is from about 2:1 to about 40:1, and wherein the step of etching an opening in said insulative layer forms a protective layer on said sidewall spacers that is from about 5 to about 50 Å thick," as recited by claim 36, or using a "plasma etchant mixture consisting essentially of ammonia and at least one fluorocarbon . . . so as to form a self-aligned contact opening defined at least in part by said sidewall spacers on adjacent gate stacks . . . wherein said contacting further forms a protective layer over opposed sidewall spacers . . . that is from about 5 to about 50 Å thick. . . [with a] flow rate ratio of . . . from about 2:1 to about 40:1, and said flow rate of said ammonia is at least about 2 sccm," as recited by claim 64.

The Office Action relies upon Tan for teaching the formation of a contact opening and for forming sidewall spacers on the sidewalls of adjacent gate stacks. Tan does

not rectify the deficiencies associated with Yanagida. The references do not teach or suggest forming a protective layer on the sidewall spacers.

Accordingly, claims 37-39 and 41-46 depend from claim 36 and are allowable for at least the reasons provided above with regard to claim 36. Claims 65-70 depend from claim 64 and are allowable for at least the reasons provided above with regard to claim 64. Therefore, the rejection should be withdrawn and the claims allowed.

Claim 19-25 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Yanagida in view of Tan and further in view of Blalock. Reconsideration is respectfully requested.

For the reasons provided above with regard to claim 1, Yanagida and Tan do not teach or suggest that the "flow rate ratio of said at least one fluorocarbon to said ammonia is from about 2:1 to about 40:1 [or] . . . that the flow rate of said ammonia is in the range from about 2 sccm to about 6 sccm." Blalock adds nothing and does not rectify the deficiencies associated with Yanagida and Tan.

Accordingly, claims 19-25 depend from and include all of the limitations of independent claim 1 and are allowable for at least those reasons provided above with regard to claim 1.

In view of the above, each of the presently pending claims in this application is believed to be in immediate condition for allowance. Accordingly, the Examiner is respectfully requested to pass this application to issue.

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Respectfully submitted,

By____________________

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